Benchmarking Defense Manufacturing

A Means to Rapidly Identify Improvements to an Organization's Internal Processes

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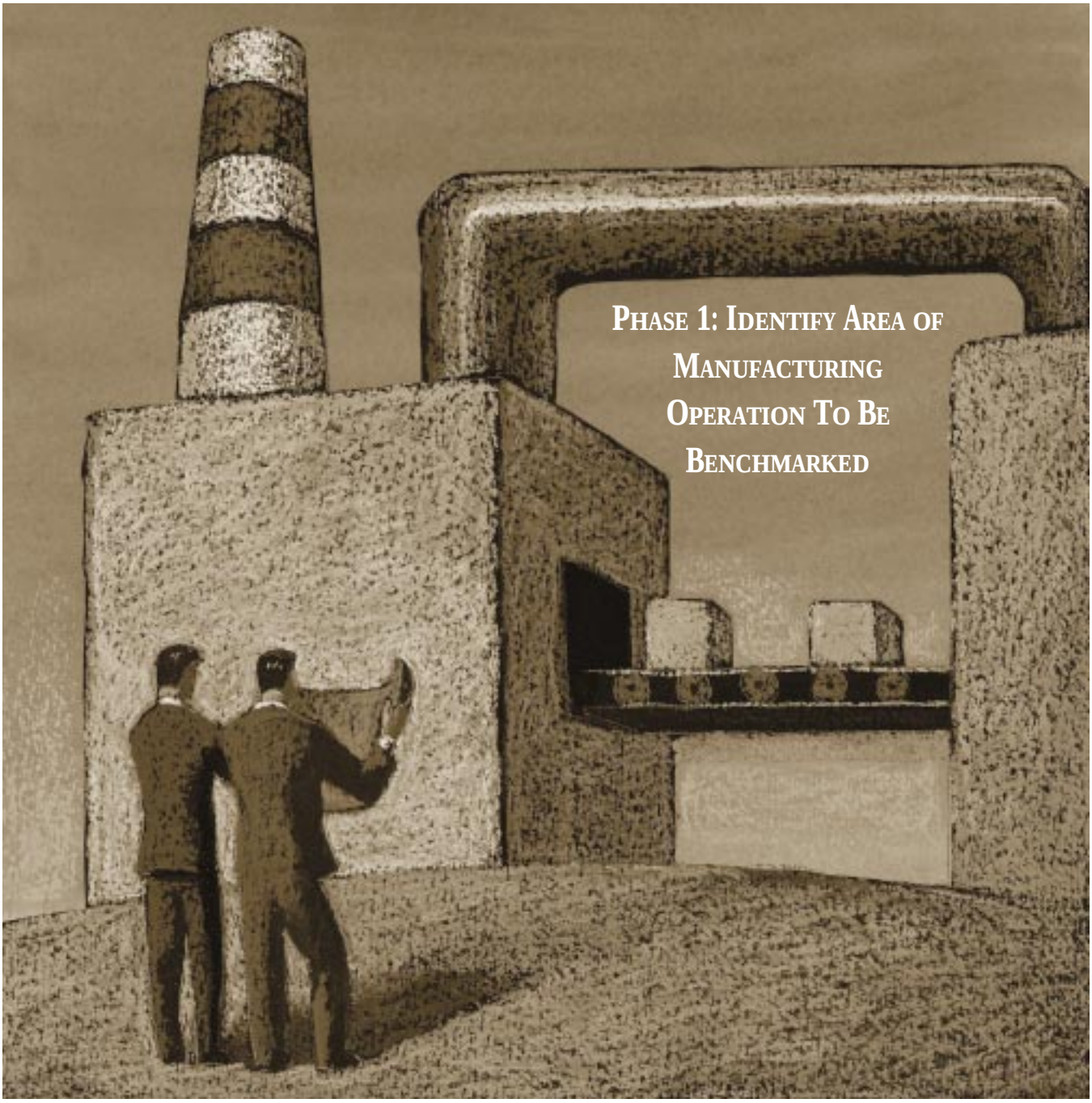

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In today's commercial markets, industries are increasingly using a management technique called benchmarking to improve critical operations and consequently their competitive edge. Over 70 percent of Fortune 500 companies, including major corporations like AT&T, Ford Motors, Eastman Kodak, IBM, Texas Instruments, and Xerox, use benchmarking on a regular basis.

Benchmarking involves comparing and analyzing the performance metrics of your organization against the known superior processes, products, and services of companies that are in and out of your competitive base. The objective of this management technique is to rapidly identify improvements you can make to your organization's internal processes. When used in conjunction with a business strategy and a process reengineering or improvement program, benchmarking can optimize your efforts to improve your operations.

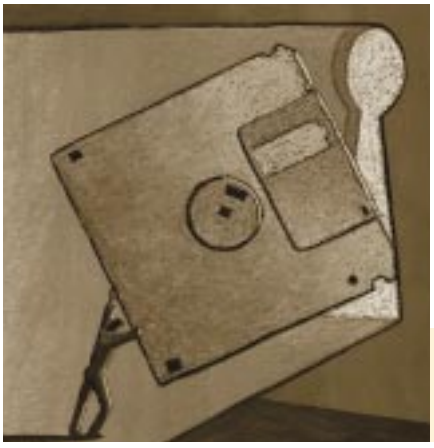
Why Benchmarking?

With the decline of defense procurements and diminishing manufacturing sources, the degree of competition in defense acquisition likely will decline. Benchmarking can help to improve Defense industry performance, thereby maintaining competition in the declining market.

Benchmarking Approaches

Benchmarking involves three main approaches:

- Internal Benchmarking
- Competitive Benchmarking
- Noncompetitive Benchmarking



Phase 2: Determine Key Performance Measures

With the decline of defense procurements and diminishing manufacturing sources, the degree of competition in defense acquisition likely will decline. Benchmarking can help to improve Defense industry performance, thereby maintaining competition in the declining market.

Phase 3: Identify Benchmarking Parners

Internal benchmarking involves comparing the business practices and performance measures of different departments or divisions within the same company or corporation. Making such a comparison can help identify the best practices within the corporation, and, once identified, the best practices can be implemented throughout the rest of the corporation, improving internal performance baselines.

The major advantage of internal benchmarking is that it is easy to perform. The performance data associated with the superior processes are internally available; thus, collecting the data and implementing process improvements should cost considerably less than collecting comparable data from an outside source, such as another corporation.

Of course, internal benchmarking yields data only about the best processes in the same company, which are not necessarily the best processes in the entire industry. Therefore, once the internal benchmarking is completed, benchmarking externally, either competitively or noncompetitively, is the wisest option.

Competitive benchmarking involves comparing your performance measures with the performance measures of the best-in-class companies engaged in manufacturing similar products or supplying services that are similar to yours. The major advantage of competitive benchmarking is that you can directly compare and clearly identify ways of improving your process. The major hurdle is that other companies are often reluctant to

share their performance measurement data with you, a competitor.

Noncompetitive benchmarking involves comparing performance measures with the best-in-class companies that use similar processes but are not necessarily involved in producing the same kind of product that you do. Because such companies are not competitors, they are more likely to share data. However, because their product lines and processes may not be identical to yours, you will have to normalize their performance data before you can compare it to yours.

Six Phases of Benchmarking Process

Benchmarking can be applied to any business operation. Benchmarking a manufacturing operation requires six major phases:

Phase 1. Any manufacturing operation has three major areas of focus: cost, quality, and cycle time. Which area should be benchmarked is a management decision. Management usually chooses the area that offers the greatest potential for improvement.

Phase 2. The next phase involves developing key performance measures for the area or areas of focus. Figure 1 depicts examples of performance measures for the three areas of manufacturing operation.

Phase 3. The choice of a benchmarking partner depends on the benchmarking approach you use. In internal benchmarking, the divisions within your company or corporation are the likely partners. In competitive benchmarking, the partner is a direct competitor. Not surprisingly, however, trying to convince a direct competitor to participate as a benchmarking partner is difficult. If the direct competitor is an overseas company, you should evaluate your return on investment for conducting a similar benchmarking study.

Phase 5: Determine Performance Gaps & Determaine Root Cause

For noncompetitive benchmarking, consider best-in-class companies using similar manufacturing processes, not necessarily similar product lines. Convincing such companies to become benchmarking partners generally is not difficult because they are not in direct competition with your organization. Figure 2 presents some examples of manufacturing-related, best-in-class companies.

Phase 4. Once you have a benchmarking partner, start collecting performance data. Either send a questionnaire to the other company or visit the site. Sending a questionnaire is less expensive, but the reliability of the data may be questionable. Visiting a site is more expensive, but the data may be more reliable because you can verify and validate it.

Phase 5. Based on the performance measure data, generate metrics for the participating benchmarking companies. These metrics provide information on the strengths and weaknesses of each company and identify gaps in the performance measures between the benchmarking companies.

Phase 6. Next, analyze the root causes of the gaps. Such analysis will require evaluating the superior company's manufacturing management policy and process, design and manufacturing tools, quality assurance practices, and approaches to reducing cycle times. Use the results of the analysis to formulate a plan for changing your own processes. Base the plan on cost benefit analysis, and the schedule for implementation will follow.

FIGURE 1. Example — Performance Measures: Three Main Areas of Manufacturing Operation

Manufacturing Cost

Direct Material
- Unit Cost
- Yield/Defect Rate

Direct Labor
- Labor Hours by Function
- Unit Productivity
- Management to Direct Labor Ratio

Indirect Costs
- Indirect Material
- Unit Cost
- Indirect Labor
- Head Count

Management to Indirect Labor Ratio

Quality

Manufacturing Yield
Amount of Scrap/Rework
Mean Time Between Failures
Quality Assurance Methodology
(e.g., Statistical Process Control)

Cycle Time

Product Development Times
Procurement Lead Times
Manufacturing Lead Times

Phase 4: Measure Performances & Develop Metrics

Potential Defense Applications

Benchmarking could be useful with most Defense weapon systems — aircraft, helicopters, satellites, tracked vehicles, ships, or missiles — and with our Depot maintenance services and manufacturing.

Aircraft, helicopter, and satellite systems have Defense as well as commercial manufacturing lines. Initial performance improvement can be achieved by internal benchmarking, comparing performances directly with the commercial lines. Further improvements in the performance can be achieved by external benchmarking, comparing performances with best-in-class companies.

For benchmarking tracked vehicles, shipbuilding, and missiles, no domestic commercial producers of similar products exist. However, many aspects of commercial manufacturing management processes are comparable to the processes used to produce tracked vehicles, ships, and missiles.

One option is to benchmark noncompetitively with domestic commercial manufacturers that have subsystems similar to the subsystems of tracked vehicles, shipbuilding, and missiles. Another option is to benchmark competitively with those foreign manufacturers of similar hardware who are willing to participate.

As for government depot maintenance services and manufacturing, benchmark internally. The performance measures can be directly compared to those of the private-sector maintenance services and manufacturing operation.

Two approaches to initiating and performing benchmarking in Defense manufacturing are possible: Defense manufacturers, themselves, can take the initiative by benchmarking with their in-house resources; and independent consultants can do benchmarking analyses.

The first option is more desirable because the manufacturers know more about their manufacturing management processes and their performance measures; they are aware of their strengths and weaknesses. Also, benchmarking with in-house resources costs less and takes less time.

The second option, however, offers one advantage: an outsider looks at the company and may offer innovative ideas for improvements.

Final Note

Benchmarking helps users derive the benefits of competition in a noncompetitive market. Moreover, it helps defense industries and the Department of Defense establish a baseline of their performance measures. It also identifies areas for potential improvement and assists in developing a plan for achieving improvements.

Benchmarking should not be perceived as a one-time data gathering exercise; but rather as an ongoing management technique for improving products and services. The emphasis should not be on the performance data, but on the underlying process that produces the data.

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FIGURE 2. Example — Manufacturing-Related, Best-in-Class Companies

Concurrent Engineering	**Manufacturing Management**
Boeing Co., Seattle, Wash.	Corning Inc., Corning, N.Y.
3M Corporation St. Paul, Minn.	Hewlett Packard Co., Palo Alto, Calif.
Manufacturing	**Flexible Manufacturing**
Hewlett-Packard Co. Palo Alto, Calif.	Allen Bradley Co., Milwaukee, Wis.
Texas Instruments Inc., Dallas, Texas	Baldor Electric Co., Fort Smith, Alaska
Design for Manufacturing	**Quality Management**
Digital Equipment Corp., Maynard, Mass.	Texas Instruments Inc., Dallas, Texas
Motorola, Inc., Schaumburg, Ill.	Digital Equipment Corp., Maynard, Mass.

Phase 6: Develop Improvement Plan & Implement Appropriate Practices

Shaping an NMD Acquisition Strategy

Do We Have It Right?

CAPT. MARK FALKEY, U.S. NAVY • PETER STARNELL

So, you're feeling pretty good about yourself. You've just finished fielding the next generation, hyper-technology, space superiority fighter below cost and well ahead of schedule. The user loves you, and the Office of the Secretary of Defense (OSD) can't say enough about your accomplishments.

You're also an Acquisition Category Level III (ACAT III) qualified program manager (PM) with a Master's in Aerospace Engineering and a Ph.D. in Systems Management, and your record boasts hands-on operational experience, as well as 20 years of coming up through the program office ranks.

Okay hot shot, here is your next assignment: You have just been named the PM of the National Missile Defense (NMD) Program, which the Under Secretary of Defense for Acquisition and Technology (USD[A&T]) recently designated an ACAT ID program. Your mission — characterized as a "3+3" strategy — is threefold:

- Complete development of an initial system in three years and be prepared to begin deployment.
- If told to do so, begin and complete deployment of the initial system in three years.
- If told not to deploy, maintain the option to deploy while continuing the evolutionary development of system capabilities.

The initial conditions are complex and extremely diverse:

THE PAYLOAD LAUNCH VEHICLE (PLV) FOR THE BALLISTIC MISSILE DEFENSE ORGANIZATION'S NATIONAL MISSILE DEFENSE (NMD) PROGRAM INTEGRATED FLIGHT TEST (IFT) -1 IS PICTURED HERE IN THE LAUNCHER AT MECK ISLAND, KWAJALEIN MISSILE RANGE. THE PLV CONSISTS OF MINUTEMAN II SECOND AND THIRD STAGES AND IS USED TO LAUNCH NMD EXOATMOSPERIC KILL VEHICLE (EKV) PAYLOADS PENDING DEVELOPMENT OF A DEDICATED BOOSTER BY THE LEAD SYSTEMS INTERGRATOR CONTRACTOR. THE PAYLOAD SHROUD CONTAINS THE SENSOR PAYLOAD PACKAGE.

Falkey is the Director for Program Management and Control within the NMD Joint Program Office located in Crystal City, Arlington, Va. A veteran of Vietnam, Grenada, and the Gulf War, he was the first Program Manager of the Joint Simulation System in Orlando, Fla.

Starnell escaped from Prague, Czechoslovakia, in 1948, spent 20 years in systems acquisition with the U.S. Air Force, and has 10 years as Manager of Acquisition Policy with TASC, Inc.

- The threat your system is to counter is elusive. It spans a spectrum from simple to complex; it may emerge from any one of several adversaries; and, there is not consensus regarding when it is expected to emerge.

- The U.S. Space Command is responsible for establishing system requirements, but each Service could be a user.

- The system consists of elements that are systems unto themselves and which, to date, have been technology efforts contracted for and executed by the Army, Air Force, and the Ballistic Missile Defense Organization (BMDO).

- The Army, Air Force, and BMDO have strong opinions as to the program's technical content and how it should be managed.

- Your "Program Office" grew from a Directorate within the BMDO. You are approximately 40 percent understaffed.

- You are moving headlong into the Quadrennial Defense Review (QDR) process and the Defense Acquisition Board (DAB) with a program that is significantly underfunded.

- While there is no set deployment date and your development efforts must be Anti Ballistic Missile Treaty-compliant, strong Congressional factions continue to push for deployment of an initial capability which may not be Treaty-compliant.

- Finally, current USD(A&T) direction reiterates support of the "3+3" strategy and requires the immediate establishment of a Joint Program Office with you as the PM reporting directly to the Director, BMDO. And, oh by the way, you should be ready for a DAB-level review of your acquisition strategy and proposed program baseline by mid August 1997 — which leaves you about 45 days before you have to initiate the Integrated Product Team (IPT) process in preparation for the review.

Any questions?

Yes, There's a Plan

While obviously tongue-in-cheek, this scenario is what faced Army Brig. Gen. Joseph M. Cosumano, Jr., on April 1, 1997, when he assumed program manager responsibilities for the National Missile Defense (NMD) Joint Program Office.

Q

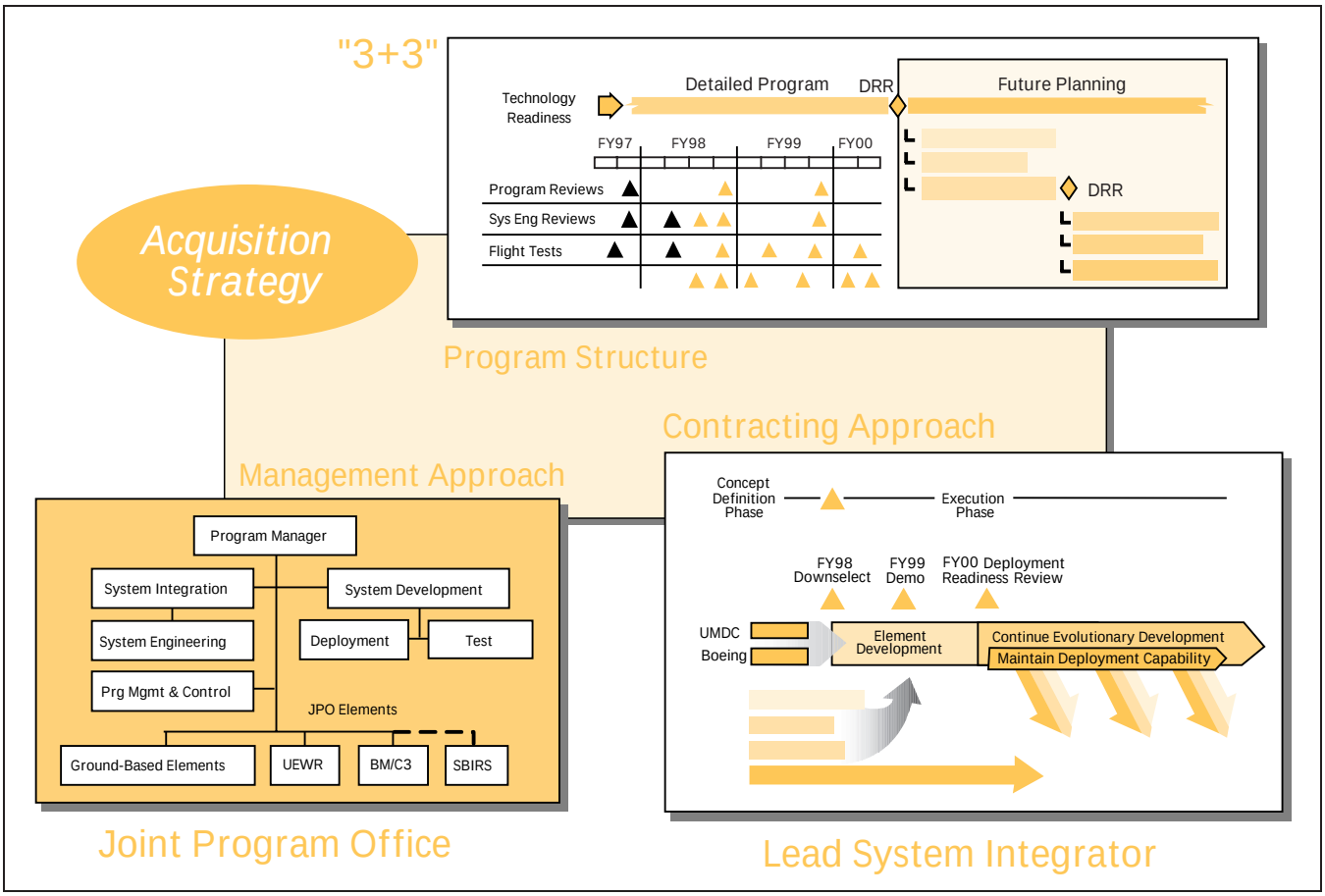
What did he manage to come up with in 45 days to kick off the Department's new consensus building IPT process?

A

A unique strategy to fit a very unique set of program requirements.

The NMD acquisition strategy depicted in Figure 1 consists of three principal

FIGURE 1. NMD Acquisition Strategy



elements, each of which is designed to address specific concerns of the program.

Program Structure

The first element, Program Structure, addresses the concern of how to adapt the DoD acquisition life-cycle model, with multiple phases and milestones that usually yield cycle times of 12 to 16 years, to a program that must achieve a six-year cycle time. The resultant structure shown in Figure 2 is non-recognizable in terms of the DoD milestones and phases, but satisfies program needs while parceling the program into logical increments separated by key decision points necessary for effective OSD oversight.

The program is structured in two phases. The Initial Development Phase has been planned in detail. Shown in Figure 2 is the first layer of major events. Supporting this are several more layers of master integrated schedules and critical path analyses that indicate the schedule is executable, albeit high-risk.

The plan calls for annual program reviews leading to the first Deployment Readiness Review (DRR) in FY00 at which the USD(A&T) will decide whether or not to deploy the initial capability system or to continue evolutionary development. His decision will be influenced by several factors: an assessment of the threat; the Administration's position regarding deployment and the ABM Treaty; Congressional willingness to allow deviations from statutory requirements; and the existence of a viable deployment option. Viability will be assessed based on specific deployment readiness criteria currently being developed by the program office.

> As one could have predicted, when the PM initiated the IPT process to obtain buy-in and consensus on the proposed strategy, he encountered resistance.

The follow-on Continued Development Phase is notional at the present time. It reflects a vision of the way the program will be executed, but the details are much dependent on the results of ongoing contractor trade-off studies and the Defense Acquisition Executive's (DAE) decision at the FY00 DRR.

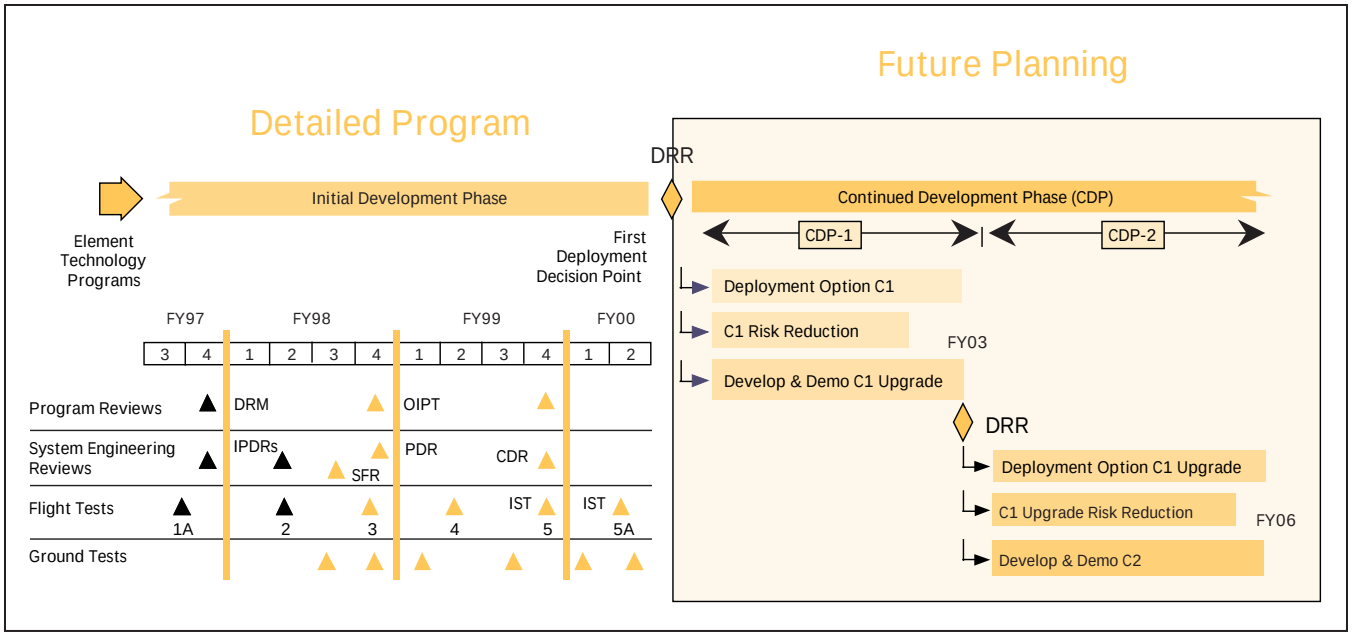
What is envisioned is a series of repeating periods, each of which starts with a DRR at which the content of the upcoming period is decided and baselined in the formal sense of the word. Progress through the period is measured against this baseline. In this way, everyone's expectations should be the same based on documentation that reflects the work planned to be accomplished.

The content of the work in a period is based on the DAE's decision regarding: deployment; continued risk reduction of the deployment option on the table; and the proposed upgrade development and engineering. This approach is similar to the Global Command and Control System Evolutionary Acquisition Strategy[1] which avoids focus on a grand design solution and breaks down a huge problem into manageable chunks. In this way, tangible products are fielded quicker and grow with technology and the user's changing needs.

Management Approach

The second element of the strategy, the Management Approach, reflects perhaps the most formidable challenge facing the new PM – how to forge one acquisition team from a set of disparate technology efforts, dispersed all over the country and among at least two Services and multiple agencies, each with

FIGURE 2. NMD Program Structure



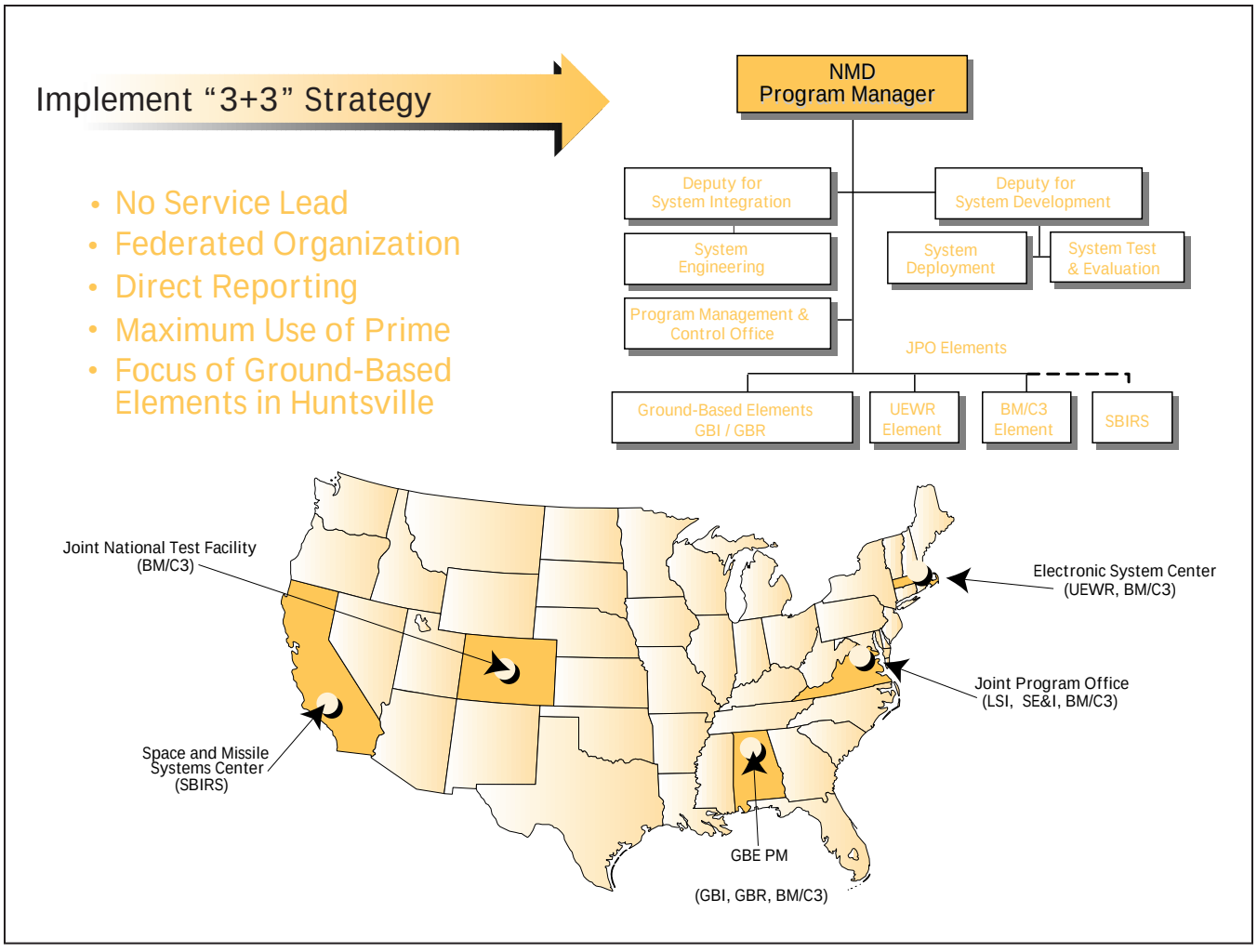


FIGURE 3. NMD Joint Program Office

vested interests and admittedly good ideas as to how the program should be managed.

After many meetings spanning several months with all of the involved principals, it was established that a Joint Program Office (JPO) would be formed. In the words of Secretary Cohen..."This PO will not be comprised of a single office located in Washington, but is envisioned as a geographically distributed organization with the people located where they can best manage the aspect of the program for which they are responsible. This 'virtual' or federated approach..."[2]

In addition, unlike all other JPOs, it was decided not to assign a Lead Service. Thus, the NMD JPO would remain an organizational element of the BMDO with the NMD PM reporting directly to the Ballistic Missile Defense Acquisition Executive. Similarly, the system element program/project/product managers, a part of the JPO but located in the Service product development centers, would report to the NMD PM. Figure 3 shows the JPO structure as it evolved to support the "3+3" concept.

Contracting Approach

The third element of the strategy, the Contracting Approach, addresses a long-standing concern among many government PMs: how to avoid placing responsibility for overall system integration and performance on the government.

Government acceptance of these responsibilities has always been a high-risk approach, even in the days of robust program offices (let alone in today's lean environment). Consequently, for a program like NMD with exceptionally difficult integration problems, establishing a means to improve the likelihood of successfully integrating the NMD system became a high priority for the JPO.

Their proposed solution was to put in place a single contractor to accept system integration and performance responsibility. Dubbed the "Lead System Integrator" or LSI, the contractor would gain, over time, contractual responsibility for the overall system as existing contracts are completed or terminated, as appropriate, by the government. The LSI would then write new contracts with the necessary contractors. After convincing skeptics in the building, the only question remaining was whether the defense industry would step up to the challenge.

The JPO planned a two-phased approach. First, in open competition, contractors would compete for a six-month study phase designed to establish a dialogue with industry regarding the best way to meet the very stringent demands of the "3+3" concept. Products would include planning documentation and key trade-off studies.

The JPO planned to award three $8 million contracts. Two bids were received – one from the United Missile Defense Company (UMDC), a joint venture among Lockheed Martin, Raytheon, and TRW; and the other from a Boeing-led team. The two contracts were awarded four months after Request for Proposal (RFP) release, and the contractors are currently competing for the single, follow-on award for the execution phase of the LSI effort. So far, the process for bringing on the LSI has worked very well. Reasons for this success include several initiatives:

LSI Home Page. The use of a widely acclaimed LSI Home Page on a limited-access, secure Internet site. Seventy-seven potential bidders received the draft RFP and subsequent procurement-related information through this medium. Having the contractors participate in this manner to refine the RFP reduced development time and led to a higher-quality product. Improved proposals, in turn, reduced evaluation time.

"Hot News" Features. In addition, near real-time "Hot News" features appear regularly, as do updates to the RFP. This innovation provides answers to contractor questions and informs all interested parties of "Hot News" as quickly and efficiently as possible. The cost of providing information in this way was insignificant compared to the routine, paper-intensive alternative.

Statement of Objectives. Perhaps more than any other program, NMD requires innovative solutions to solve issues such as how to achieve a three-year deployment time. Routine solutions simply will not work. To foster such innovative "out-of-the-box" thinking, the JPO used a Statement of Objectives (SOO) vice a detailed Statement of Work to provide as much latitude in contractor responses to the RFP as possible.

> "This [Joint] PO will not be comprised of a single office located in Washington, but is envisioned as a geographically distributed organization with the people located where they can best manage the aspect of the program for which they are responsible."

Contractor Flexibility. The contractors are allowed complete latitude to define accomplishment criteria, i.e., what the DRR should address. The government is establishing cost and schedule, so the contractors are being given maximum flexibility to define content.

Innovative Source Selection Procedures. Evaluation standards are being provided the contractors so they can better tailor their proposals to meet JPO needs. Draft proposals for the execution phase of the contract are being accepted by the government so that the evaluation team can begin early to understand the contractor's approach. And, the government's best value requirement focuses on the total cost of ownership rather than simply system acquisition cost.

If the current schedule holds, it will have taken the JPO approximately 16 months to bring the LSI on-board, or about the same amount of time had they simply selected, and spent about six months acclimating one contractor up-front. The principal advantage of the approach the JPO used is that the risk of selecting a less-qualified contractor is mitigated through the interaction between the government and the competing contractors in the six-month study/planning phase.

Resistance? Of Course!

As one could have predicted, when the PM initiated the IPT process to obtain buy-in and consensus on the proposed strategy, he encountered resistance. The two most pervasive issues were the lack of "Milestones" and the impact of their absence on program documentation and oversight; and how much of the QDR-recommended plus-up should be spent on additional testing.

The good news? The process worked. Not without pain and a lot of maintenance, but it worked! So well, as a matter of fact, that only a paper DAB was required and the Principal Deputy USD(A&T) commented at some length during the DAB Readiness Meeting as to the innovative nature of the strategy and how all programs should consider similar approaches to cut cycle time.

Will it work? It's simply too early to tell. Support of the program and its unique approach grows every day from all corners of the acquisition community. The program's momentum is building. Continued success in flight testing will be a big factor. The LSI will be a tremendous help. But, as the PM is quick to remind, the program remains high-risk, primarily because of schedule. Therefore, he is understandably reticent about endorsing such a radical departure from the Department's conservative model to other PMs who may not be faced with similar programmatic demands.

Okay, your turn. What would you do? I'm interested in hearing your comments or suggestions. Send them via E-mail to the following address: **peter.starnell-contractor@bmdo.osd.mil.**

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